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Extended Abstract

Texture Mapping on NURBS Surface †

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Abstract: Texture mapping allows high resolution details over 3D surfaces. Nevertheless, texture mapping has a number of unresolved problems such as distortion, boundary between textures or filtering. On the other hand, NURBS surfaces are usually decomposed into a set of Bézier surfaces, since NURBS surface can not be directly rendered by GPU. In this work, we propose a texture mapping directly on the NURBS surfaces using the RPNS (Rendering Pipeline for NURBS Surface) method, which allows the rendering of NURBS surface directly on the GPU. Our proposal facilitates the implementation while minimizing the cost of storage, mitigating distortions and stitching between textures.

Keywords: NURBS; texture; shader; GPU

1. Introduction

NURBS (Non-Uniform Rational B-Splines) [1] surfaces are one of the standards for data representation, design and exchange in CAD/CAM/CAE applications. NURBS surfaces with textures allows a more realistic representation of the surfaces, improving the final scene in areas such as modeling, virtual reality or animation [2]. Texture mapping presents a set of problems that usually require user intervention [3]. The application of texture NURBS surfaces implies a high cost of storage due to the utilization of techniques such as texture atlas generation [4]. In this work we propose a texture mapping directly on the NURBS surfaces using RPNS (Rendering Pipeline for NURBS Surface) [5]. RPNS is a solution for the direct evaluation of NURBs surface on the GPU without any previous decomposition to Bézier surfaces.

2. Texture Rendering

RPNS adds a new primitive to the input flow of the geometry stage, KSQuad. In addition, an intermediate stage, the sampler, is added between the geometry and the rasterization stages, as shown in Figure 1. In this stage, KSQuad primitives are sampled adaptively according to the point of view, the geometric characteristics of the surface, and the contour edges between surfaces. This sampling results in a set of sampling points or dices called KSDice that allow the surface to be rendered without cracks or holes. Each KSDice consists of a sampling point and additional information such as the parametric size of the matrix and the grade of the corresponding surface, and does not store any explicit connectivity information. KSDice is a primitive that can ultimately be projected to a single pixel or a set of pixels.

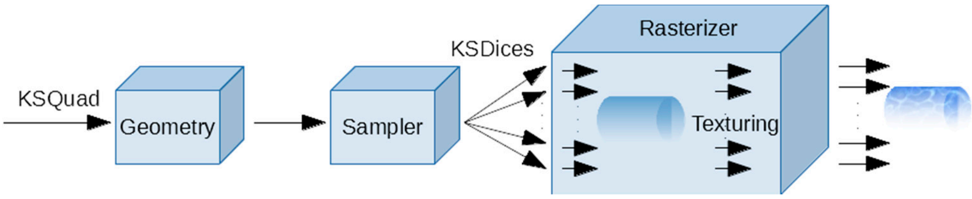
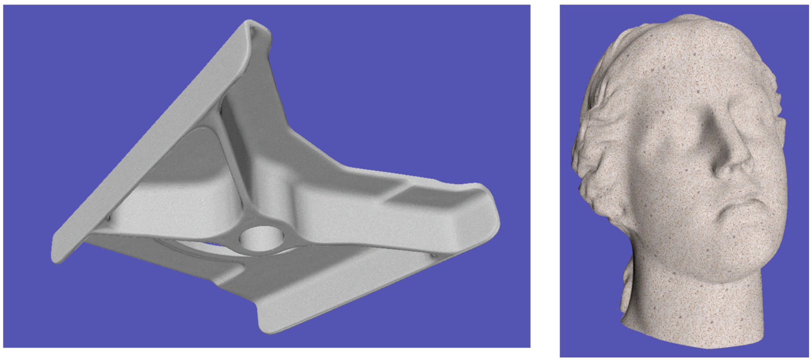


Figure 1. Rendering texture mapping pipeline for NURBS surfaces.

In the implementation of our proposal, we make use of Texture2DArray, a type of texture coordinated with DirectX and HLSL5 (High Level Shader Language), that allows the definition of colors directly on the KSDices.

3. Results and Conclusions

In this section we present the results obtained on different models (Figure 2) with our proposal. The platform on which the different tests were performed consists of an Intel i7-4790 3.6 GHz with 32 GB of RAM and a NVidia GTX 1080ti with 11GB GDDR5X. As for the software, the tests were conducted on Windows 10 using Visual Studio Community 2017 with DirectX 11 and Microsoft HLSL.



(**a**) (**b**)

Figure 2. NURBS Models: (**a**) Hinge; (**b**) Head.

Our proposal shows how NURBS surface can be used with textures without previous transformations.

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